CompTIA Printing and Document Imaging (PDI+) Certification Examination Objectives

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INTRODUCTION

The CompTIA Printing and Document Imaging (PDI+) certification is a vendor neutral credential that certifies that an individual has the required knowledge and skills of the core operations of printing and document imaging devices.

The CompTIA PDI+ certification is aimed at the **entry-level** technician or support person involved with printer, copier, scanner, fax and multi-function peripherals. The successful candidate will provide installation, connectivity, maintenance, troubleshooting and repair services using professional communication skills while supporting printing and document imaging devices.

The individual that receives the CompTIA PDI+ certification validates that he/she has:

- The ability to resolve most printing and scanning problems
- The ability to perform installation, repairs and maintenance but may require troubleshooting / diagnosis assistance from higher level technical support
- An adequate level of communication and professional skills
- Some ability to diagnose connectivity related problems

CompTIA PDI+ serves as a solid foundation for entry into a career involving the service and support of printing and document imaging devices. It also provides a stepping-stone towards Original Equipment Manufacturer (OEM) training for authorization on specific devices.

The table below lists the domain areas measured by this examination and the approximate extent to which they are represented in the examination:

Domain	% of Examination
1.0 Print Engine Process and Components	21%
2.0 Scan Process and Components	10%
3.0 General Troubleshooting	23%
4.0 Basic Electromechanical Components and Tools	13%
5.0 Connectivity	11%
6.0 Color Theory	8%
7.0 Professionalism and Communication	8%
8.0 Safety and Environment	6%
Total	**100%**

The skills and knowledge measured by this examination are derived from an industry-wide Job Task Analysis (JTA) and were validated through a global survey in Q2, 2007. The results of this survey were used to validate the content of the domains and objectives and the overall domain weightings, ensuring the relative importance of the content.

1.0 Print Engine Process and Components

1.1 Define, describe and demonstrate an understanding of the following commonly used printing processes:
- Identify and describe basic steps of laser / LED printing
  - Photoconductor preparation, charging, writing, developing, transferring, fusing
    - Photoconductor preparation
      - Removal of residual toner by cleaning blade, brush or roller
      - Removal of residual charge by light or electrical charge
    - Charging
      - Supply uniform charge to the photoconductor surface by charge corona or charge roller
    - Writing
      - Laser or LED creates a latent image by discharging the appropriate areas of the photoconductor
    - Developing
      - Toner is attracted to the latent image
    - Transferring
      - Toner is transferred from the photoconductor to the media by using electrostatic charges
    - Fusing
      - Toner is fixed/fused to the media with heat and pressure
- Identify and describe basic steps of Ink dispersion printing
  - Purging, ink delivery, image application to media
    - Purging
      - Cleaning the heads and nozzles
    - Ink delivery
      - Ink is moved from reservoir to print head
      - Unidirectional and Bi-directional printing
    - Image application to media
      - Ink is delivered through the nozzles (print head) directly to media via heat/charge

1.2 Identify and describe print process components and their functions
- Laser or LED image formation components
  - Photoconductor
  - Laser Unit (beam detector, polygon mirror / motor, laser diode, toner shield) or LED unit
  - Developer Unit (toner supply, mono component, vs. dual component)
  - Charge assembly
  - Cleaning Unit (residual toner removal)
  - High Voltage Power Supply
  - Low Voltage Power Supply
  - Transfer / separation
- Device fuser components
  - Heat roller / belt, pressure roller, lamps / heaters, thermistor, fuser cleaning components, pawls, thermal protection
- Ink dispersion image formation components
  - Print head, IDS (ink delivery system), carriage, carriage belt, ink supply, purge unit, absorption pads.
- Media transport/feed components

- o Pickup roller, feed roller, separate roller/pad, torque limiter, transport rollers, registration assembly, sensors, media guides, exit rollers, gates/diverters/deflectors, static brushes
- Ventilation components
  - o Fans, ozone filters, dust filters, ducts
- Accessories
  - o Finishers, sorters, large capacity paper source, document feeders, stapler, duplexers, punch units, folders cutters, binders, stackers, inserter.

1.3 Describe the purpose of firmware

1.4 Identify and describe print data flow and job processing
- Demonstrate awareness of the interaction between software application, driver, printer control languages, raster image processing, printing and image creation.
- Identify the impact of memory on the printer

1.5 Identify media types and explain their impact on print process, quality and device performance
- Use appropriate media types based on device specifications
- Identify and recognize paper weights, sizes and standards
- Identify and recognize paper textures, brightness, grain, coatings
- Identify and recognize other media types (ie: transparencies, envelopes, labels, card stock, raised letterhead, recycled paper)
- Describe adverse affects of improper media storage on device performance

2.0 Scan Process and Components

2.1 Identify and describe common hardware scanner components
- Lamps, mirrors, CCD, CIS, CMOS, lens, glass, analog to digital converter, color filters.
- Differentiate between ADF (Automatic Document Feeder) and flatbed component

2.2 Describe and summarize image capture in relation to scanning technologies
- Identify and describe common scanner technologies such as TWAIN and network scanning methods
- Identify the effects of using different image formats (ie: PDF, JPG, GIF, TIFF)
  - o Impact on file size, quality, scan time, network bandwidth, storage, resolution, color, depth, reduction, enlargement, compression
- Define the image capture process
  - o Light exposure, reflection, focus, filter, capture (CCD), Analog to Digital conversion, image processing.
- Recognize the reasons for and potential impact of security and anti-counterfeiting features

3.0 General Troubleshooting

3.1 Describe and apply general troubleshooting methodology
- Observation – gather information and validate the symptoms
- Establish theory of probable cause based on information gathered
  - Attempt to isolate the problem by eliminating non-causes
  - Use tools and service documentation as needed
- Test or Analyze – try to recreate the problem and validate theory
- Once theory is validated, determine next steps to resolve the problem
- Implement solution, validate solution and document actions and results

3.2 Identify and isolate printing hardware issues using available tools
- Image quality issues
  - Dark images, light images, weak images, repetitive image defects, ghosting, smearing, banding, focus, shadows, voided areas, jitters, registration issues, skew, misaligned color registration, weak color, missing color, vertical and horizontal black/white lines, black pages, blank pages, incorrect consumables
- Causes of image quality issues
  - Fuser, charging components, laser/LED component, developer assembly, consumables, photoconductor, print head, drive components, media transport/feed system, environment
- Transport/feed issues
  - Media jamming, skewing, creasing, wrinkling, folding, tearing, multifeeding, burning, misfeeding
- Causes of common media transport/feed issues
  - Media feed, fusing, media exit, registration, delivery, duplex, damaged media, separation, media feed timing, foreign objects
- Service error messages
  - Critical operational failures (service code)
- Common user informational messages
  - Add media, add supplies, add toner, regular maintenance, paper jam, incorrect media
- Testing tools
  - Print test page, event logs, configuration pages, paper path test, parts life counters, user setting list, engine test page

3.3 Identify and isolate printing software issues using the following methods:
- Verify use of appropriate drivers by checking driver type/version
- Verify driver port setting
- Print driver test page
- Proper driver accessory/option configuration
- Application settings vs. driver settings
- Installing and uninstalling drivers
- Confirm driver settings: "offline vs. online"
- Print from multiple applications and workstations
- Print different files from the same application

3.4 Identify and isolate scanning hardware issues using available tools

- Image quality issues
    - Dark images, light images, weak images, banding, focus, shadows, voided areas, jitters, registration issues, skew, misaligned color registration, weak color, missing color, vertical and horizontal black/blank lines, black pages, blank pages
- Common causes of image quality issues
    - White reference plate, scan lamp, glass contamination, mirrors, lens, CCD, focus, alignment, cables, automatic document feeder, rollers, improper calibration, limited memory, defective storage device
- Service error messages
    - Critical operational failures (service code)
- User informational messages
    - Media jam
- Testing tools
    - Test / target chart, calibration strip

3.5 Identify and isolate scanning software issues

- Verify use of appropriate drivers by checking driver type/version
    - TWAIN, WIA, ISIS
- Verify and configure application settings
    - Resolutions, color depth, single sided vs. duplex, media size, exposure levels, file format, reduction and enlargement, ADF vs. flatbed, monochrome vs. color

3.6 Identify and isolate basic connectivity issues using available tools

- Connectivity issues
    - Slow printing, intermittent activity, communication errors, unexpected output, no activity
- Common causes of wired and wireless connectivity issues
    - Loose, broken, damaged, improperly wired cables, broken network devices (hubs, switches), incorrect protocol / network settings, incorrect TCP/IP settings, bad network card, firmware, interference, line of sight, EMI
- Service or informational messages
    - Refer to manufacturer documentation for error codes and messages

3.7 Identify and isolate faxing issues

- Common fax issues
    - Cannot send, cannot receive, random disconnections, speed, reception/send image quality
- Common causes of faxing issues
    - Bad fax card, noise on the line, line levels, non-analog line, bad cable, wrong port, inappropriate document orientation, DSL interference, call-waiting, line share devices, firmware, no dial tone
- Identify similarities between faxes and scanners as it relates to image quality issues when transmitting faxes or copying
- Identify similarities between faxes and printers as it relates to image quality issues when receiving faxes or printing

4.0 Basic Electromechanical Components and Tools

4.1 Identify and explain the function of electromechanical components
- Clutches
- Solenoids
- Motors (ie: stepper motors, AC/DC motors)
- Relays
- Sensors (ie: photo reflective, encoders, photo interrupters)
- Switches (ie: micro switches, magnetic switches)

4.2 Identify and explain the function of mechanical components
- Drive components
  - Gears (ie: one way, gear trains)
  - Bearings
  - Bushings
  - Belts
- Rollers (ie: rubber, teflon, steel, etc)
- Cams
- Cables
- Pulleys / Idler
- Springs

4.3 Identify and explain the function of electrical components
- Power supplies (ie: low and high voltage)
- Fuses
- Thermistors
- Thermal switches/fuses
- Lamps (ie: halogen, xenon, LED)
- Grounding components (ie: screws, shields, points, straps, wires)
- Cables (ie: copper wire harnesses, flat cable, fiber optics)
- Connectors (ie: ZIF sockets, Molex, Ultrex, spade, pin connectors, spring contacts)
- EEPROM and EPROM (ie: NVRAM)
- Memory
- Control PCBs (Printed Circuit Boards) (ie: I/O boards, drivers boards, logic boards, fax board, network card)

4.4 Demonstrate the proper and safe use of tools
- Multimeter
- Polarity tester
- AC line monitors
- Toner Vacuum and toner rags
- Service documentation (ie: theory of operation, block diagram and wiring / circuit diagram)
- Lubricants and cleaning solutions
- Test chart
- Chip puller / EEPROM puller

4.5 Demonstrate and follow recommended maintenance guidelines and practices. Define the reasons and benefits for adhering to maintenance guidelines and practices.
- Examine device log data and previous service history
- Scheduled preventative maintenance
  - Replacing parts based on parts life counters
  - Check firmware version and update as necessary
  - Clean, lubricate and perform adjustments per device specifications
- Unscheduled service calls
  - Perform preventative maintenance during service calls
  - Examine device for potential future problems
  - Clean, lubricate and perform adjustments per device specifications
- Verify device functionality

5.0 Connectivity

5.1 Identify and describe basic network and communications technologies
- Protocols
  - TCP/IP
- Communication settings
  - 10/100/1000 Mbps
  - Dialog modes (ie: simplex, half/full duplex, auto negotiation)
- Physical connections
  - Port types (ie: RJ-45)
  - Cable types (ie: UTP, STP, CAT-5 crossover/standard cable)
  - Network interface card
- Wireless connectivity
  - 802.11x, SSID, WEP-WPA encryption, infrastructure vs. adhoc
  - Bluetooth, infrared
- Fax / modem
  - Port types (ie: RJ-11)
  - Analog phone line
  - Transmission speeds (ie: baud rates)

5.2 Describe and demonstrate the use of the TCP/IP protocol and related tools
- Static addressing
  - IP address, Subnet mask, Default gateway, DNS
- Dynamic addressing
  - DHCP
  - APIPA
- Validate network connectivity using tools and utilities
  - PING, IPCONFIG, TELNET, NSLOOKUP, web browser, configuration page, cross-over cable
  - Link lights (LEDs), Activity lights

5.3 Identify the basics of network scanning technologies
- Requirements to utilize Scan to Email functionality
  - SMTP, authentication, POP3, LDAP, file size limitation
- Requirements to utilize Scan to Folder functionality
  - Shared folder on network, permission levels, SMB, UNC path
- Requirements to utilize Scan to File functionality
  - Application based, drivers, TWAIN, ISIS
- Requirements to utilize Scan to FTP functionality
  - FTP server, permissions

5.4 Identify the basic purpose and use of printer drivers
- Install, remove and update drivers (using Windows 2000 and XP)
- Verify driver versions
- Follow manufacturer documentation when installing USB devices (software vs. hardware install)
- Basic features and settings of printer drivers
  - o Duplex printing, tray settings, media settings, paper sizes, finishing, quantity, scaling
- Printer control languages
  - o PCL, Postscript, GDI, PJL
  - o Demonstrate awareness of vendor specific drivers and languages
- Spooling
  - o Operation and configuration
- Differentiate between shared printing and direct printing
- Demonstrate awareness of the effect of application settings on driver settings

5.5 Identify common device ports
- Types of physical ports
  - o LPT, USB, Serial, Firewire, Parallel, miniparallel, SCSI
- Types of memory card slots
  - o SD Slot, Compact Flash
- Type of network ports
  - o LPR, RAW, port 9100, SMB – Simple TCP/IP, External print server port
- Assignment of printer driver to ports

6.0 Color Theory

6.1 Identify and describe the basics of color theory
- Differentiate between additive and subtractive color (RGB vs. CMYK)
- Describe color gamut and its relationship to device limitations
- Explain perception of color and what affects perception
  - o Light, media, contrast, the observer

6.2 Define and explain basic color management
- Identify how color adjustments affect the quality of image output
- Describe the need for color calibration

7.0 Professionalism and Communication

7.1 Define and demonstrate effective communication and relationship building skills
- Use appropriate introduction
- Use active listening skills
- Probing: Asking open ended and closed ended questions
- Show empathy for the customer
- Speak clearly and concisely at all times
- Use appropriate terminology for the audience
- Clarify and confirm the customer's expectations and/or concerns
- Provide closure for the client at the end of the service call
- Communicate status of repair and/or open issues – follow up calls when necessary
  - o Use articulate and legible written communication

7.2 Define and demonstrate effective communication skills with technical support
- Follow appropriate escalation procedures
- Call from onsite and have appropriate reference materials available when speaking with technical support
- Describe the problem, service history and troubleshooting steps accurately with appropriate terminology
- Clarify and confirm technical support recommendations
- Follow further escalation procedures if necessary

7.3 Display and practice professional conduct with internal and external customers/contacts
- Maintain a positive attitude concerning the manufacturer of the product
- Treat the customer with courtesy and respect, including the customer's property
- Act as liaison between internal and external customers
- Take ownership of the issues and follow through to its conclusion

8.0 Safety and Environment

8.1 Demonstrate and apply safety procedures
- Use proper ESD (Electrostatic Discharge) practices and proper grounding techniques
  - Wrist straps, static mats, unplugging / lockout / tagout
- Demonstrate proper use of cleaning solutions and sprays
- Identify potential safety hazards
  - Heated rollers, electricity, sharp edges, airborne toner, moving parts (be aware of clothing, jewelry, hair)
- Adhere to and follow MSDS (Material Safety Data Sheet) guidelines
- Define and demonstrate proper laser safety practices
- Follow manufacturer safety documentation for:
  - Transportation and handling of units, appropriate placement of unit and unit operation
  - Appropriate power source and power protection
  - Routing of power cords and network cables

8.2 Demonstrate an awareness of environment and environmental considerations
- Proper disposal/recycling of devices and consumed supplies according to local regulations
- Adhere to and follow MSDS (Material Safety Data Sheet) guidelines
- Describe the need for ozone filters and their replacement at regular intervals
- Describe effects of temperature and humidity on media and supplies
- Follow manufacturer safety documentation for appropriate placement of unit (ie: temperature, humidity, dust considerations, sunlight, etc)

PDI + GLOSSARY OF TERMS

LASER UNIT – device used to dissipate the charge on the photoconductor to create the latent image

REGISTRATION ROLLER – a roller driven by a motor or clutch that is used to synchronize paper travel with the image on the drum, to ensure correct placement of the image on the paper

LEAD EDGE – used to describe the edge of the media that first exits the device

TRAIL EDGE – used to describe the final edge of the media as it leaves the device

DEVELOPER – a substance composed of a carrier, usually metal-based, that adheres to the magnetic roller in the developer unit to hold toner in suspension for delivery to the photoconductor.

IMAGE TRANSFER STAGE – the step in the electro-photographic process where the toner is delivered to an intermediate transfer belt assembly from the photoconductor. Typically used on color printers.

PAPER TRANSFER STAGE - the step in the electro-photographic process where the toner is transferred on to the media. Typically used on color printers.

CONFIGURATION PAGE – internal page generated by a device showing page counts, firmware versions, internal settings, etc.

ORIGINAL DETECTION SENSOR – a sensor used to indicate to an MFP that an original has been placed in the ADF (Automatic Document Feeder)

METERING BLADE – a blade used in the developer unit to limit the amount of developer that is retained on the magnetic roller. Can be used in mono component systems to limit the thickness of toner retained on the toner supply roller. Also referred to as a doctor blade or a skimming blade.

INVERTER GATE – a plastic guide, usually controlled by a solenoid, that is used to divert media into a different path with in the MFP. Also known as a junction gate.

PDI + ACRONYMS

ADF (Automatic Document Feeder)

APIPA (Automatic Private Internet Protocol Addressing)

CAT5 (Category 5)

CAT6 (Category 6)

CCD (Charge Couple Device)

CIS (Contact Image Sensor)

CMOS (Complementary Metal Oxide Semiconductor)

CMYK (Cyan-Magenta-Yellow-Key 4 color ink model used in printing)

CRU (Customer Replaceable Unit)

DAC (Discretionary Access Control)

DC (Direct Current)

DHCP (Dynamic Host Configuration Protocol)

DIMM (Dual Inline Memory Module)

DNS (Domain Name System)

DSL (Digital Subscriber Line)

ECM (Error Correction Mode)

EEPROM (Electronically Erasable/Programmable Read Only Memory)

EM (Emergency Maintenance)

EMI (Electromagnetic Interference)

EPROM (Electronically Programmed Read Only Memory)

ESD (Electrostatic Discharge)

EXE (Executable)

FRU (Field Replaceable Unit)

FTP (File Transfer Protocol)

FW (Firmware)

GDI (Graphical Device Interface)

HCI (High Capacity Input)

HCO (High Capacity Output)

HVPS (High Voltage Power Supply)

ICB (Integration Control Board)

ICC (Image Color Consortium)

IDS (Ink delivery System)

IPB (Image Processing Board)

IrDA (Infrared Data Association)

ISIS (Image and Scanner Interface Specification)

JBIG (Joint Bi-Level Experts Group)

LCC (Large Capacity Cassette)

LCD (Liquid Crystal Display)
LCT (Large Capacity Tray)
LDAP (Lightweight Directory Access Protocol)
LED (Light Emitting Diode)
LPR (Line Printer or Line Printer Remote)
LPT (Local Printer Terminal)
LVPS (Low Voltage Power Supply)
MFD (Multi-Function Device)
MFP (Multifunction printer)
MMR (Modified Modified Read)
MSDS (Material Safety Data Sheet)
MTBF (Mean Time Between Failure)
NAND (Not AND)
NETBIOS (Network Basic Input/output System)
NIC (Network Interface Card)
NVRAM (Nonvolatile Random Access Memory)
OCR (Optical Character Recognition)
OPC (Organic Photoconductor Cylinder)
PCA (Printed Circuit Assembly)
PCB (Printed Circuit Board)
PCL (Print Control Language)
PDF (Portable Document Format)
PIU (Peripheral Interface Unit)
PJL (Printer Job Language)
PM (Preventative Maintenance)
PMF (Print File Maker)
POP3 (Post Office Protocol version 3)
PPD (Postscript Printer Description)
PRCB (Program Requirements Change Board)
PS (Postscript)
PWA (Printed Wire Assembly)
PWB (Printed Wiring Board)
RAM (Random Access Memory)
RARP (Reverse Address Resolution Protocol)
RAW (Read-After-Write)
RDF (Re-circulating Document Feeder)
RGB (Red-Green-Blue color model based on additive color primaries)
RIP (Raster Image Processor)
RPM (Revolutions Per Minute)
SCSI (Small Computer Systems Interface)
SMB (Server Message Block)

SMTP (Simple Mail Transfer Protocol)
SSR (Solid State Relay)
STP (Shielded Twisted Pair)
TCP/IP (Transmission Control Protocol/Internet Protocol)
TIFF (Tagged Image File Format)
TLD (Top-Level Domain)
TWAIN (Technology without an interesting name)
UNC (Universal Naming Convention)
USB (Universal Serial Bus)
UTP (Unshielded Twisted Pair)
VoIP (Voice over Internet Protocol)
WEP (Wired Equivalent Privacy)
WIA (Windows Image Acquisition)
WPA (Wi-FI Protected Access)
WYSIWYG (What you see is what you get)